MOVING FORWARD

OHIO DEPARTMENT OF TRANSPORTATION
RESEARCH & DEVELOPMENT

"He who does not look ahead, remains behind." (Spanish Proverb)

Ohio Department of Transportation, Office of Research and Development Fall 2003

Research Through Pooled Fund Studies

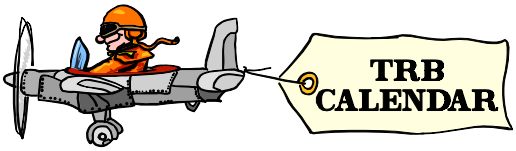
When research is proposed that may be of regional or national interest, a pooled fund study can be used to jointly fund research, planning, and technology innovation activities, giving all the partners more value per dollar. Any federal or state transportation agency can initiate a pooled fund study through the Federal Highway Administration (FHWA). Once a pooled fund is established, local and regional transportation agencies, private industry, foundations and universities may join in the partnership with the sponsoring agency.

A pooled fund study led by Ohio operates similarly to one of our standard research projects with the exception of a few additional steps in the initial stages. First, the sponsoring office develops a problem statement and may informally contact other states or agencies to determine if there is sufficient interest to set up a pooled fund study. If other agencies indicate interest, the problem statement is submitted to our office to be posted on a national Transportation Pooled Fund (TPF) website to solicit further interest and to allow participating states to make online commitments to the study. If sufficient interest is found, the Office of Research and Development requests approval from FHWA to formally establish the study as a pooled fund and allow states to use 100% SP&R (State Planning & Research) funds. R&D manages the project, maintains the contract, and handles billing and payments as usual.

The TPF website is sponsored by the FHWA and is a valuable, comprehensive resource that solicits national interest in pooled fund studies, monitors the progress of the studies, and reports the results. To check out current pooled fund studies, please see http://www.pooledfund.org/.

Upcoming TRB Conferences and Workshops

September 7-10, 2003
International Conference on Highway Pavement Performance, Data Analysis, and Design Applications
http://webce.ent.ohiou.edu/ICHP.html
Columbus, Ohio



September 9-12, 2003
Community Impact Assessment: Putting It All in Context
http://www.in.gov/dot/programs/CIAWorkshop.html
Indianapolis, Indiana

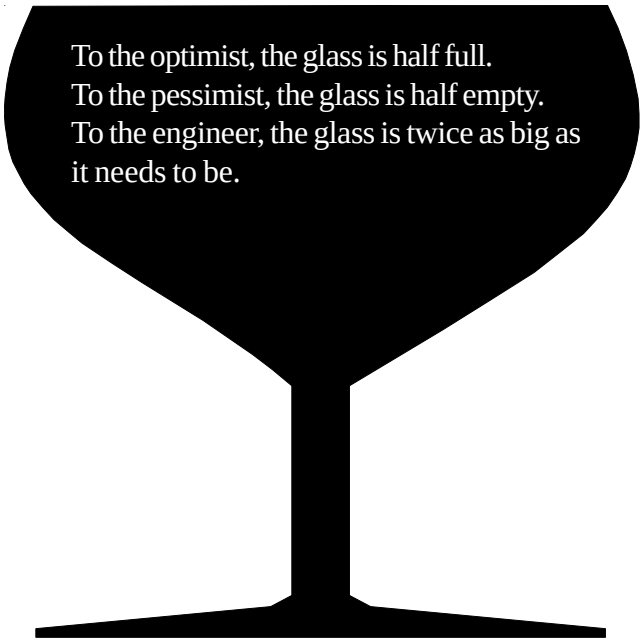
September 17-19, 2003
Tenth National Highway/Utility Conference
http://www.natlconference.com/
Orlando, Florida

September 23, 2003
Symposium on Performance of Rock Anchors *(by invitation)*
http://www.aot.state.vt.us/HighwayGeoSymposium/home.htm
Burlington, Vermont

September 29-30, 2003
5th National Conference on Asset Management - Moving from Theory to Practice
http://gulliver.trb.org/conferences/Asset/default.htm
Atlanta, Georgia

January 11-15, 2004
Transportation Research Board 83rd Annual Meeting
http://www4.nationalacademies.org/trb/annual.nsf
Washington, D.C.

Comprehending Engineers



LIFE TIME MONITORING OF A HIGHWAY BRIDGE
BY: DR. ARTHUR HELMICKI & DR. VICTOR HUNT
UNIVERSITY OF CINCINNATI

At first glance, HAM-126-0881, located along the Ronald Reagan Cross County Highway in the NW corner of Cincinnati in ODOT's District 8 seems like an ordinary highway overpass with its two piers, five steel girders and reinforced concrete deck. Driving at 55 mph, you would spend only about two seconds on it. You may not even notice it. If you did, it would look like any one of several thousand such bridges in the state's bridge inventory of over 12,000 bridges. Bridges of this type represent about 35% of the inventory, the most populous bridge type here in Ohio as well as around the nation.

You might think HAM-126-0881 looks like a normal bridge, but you would be wrong. It is actually a field laboratory where, since before it was opened to service, University of Cincinnati (UC) researchers and ODOT structural and bridge engineers have been studying what makes this bridge type tick; how it lives and breathes; and how it responds to the inputs it receives from construction workers and equipment, cars, trucks, the traveling public, and even the weather.

The HAM-126-0881 laboratory contains a suite of more than 640 sensors of various types that were embedded in and mounted on the structure during erection. The bridge approach also contains a Weigh-in-Motion (WIM) scale capable of measuring the weight, speed, and dimensions of vehicles crossing the bridge. All of these components are connected to a central cabinet housing a camera, data acquisition electronics, and a network of two PCs programmed to handle collection, processing, archiving, and display of the data collected at the site.

In addition, the HAM-126-0881 bridge has been the subject of regular controlled truckload and modal tests designed to measure various static and dynamic properties of the structure. Baseline tests were conducted in June 1997, the bridge was opened to traffic on October 28, 1997, and additional diagnostic tests were conducted in 1998 and 2002 in order to track the subsequent performance of the bridge.

The research findings and outcomes of the HAM-126-0881 project fall into two broad categories:
First, specific findings based on analysis of the data collected have shed light on steel girder bridge behavior. The research has provided an accounting of the actual absolute state of stress in a typical steel stringer bridge. For the first time, structural engineers have an understanding of the cumulative effects of fabrication, erection, and in-service phenomena on the life of a steel stinger bridge. Examples include, but are not limited to:

Fabrication and erection stresses (up to 15 ksi) not normally considered in design, were induced in the girder webs and flanges due to heat cambering and welding operations, respectively.
Significant dead load and live load stresses (up to 3 ksi) were observed in crossframes, quantities also typically not considered in design.

The measured dead load stresses of the deck and parapet were not uniformly distributed as assumed by the design, and marginally exceeded design predictions at some locations. The average stress for the interior beams at midspan (9.5 ksi) was about 20% more than what was expected from design, while the pier locations (7 ksi) were about 25% less. Also, exterior girders were found to carry more than interior girders.

While live load stresses (up to 2 ksi for daily traffic) are well within the design limits, environmental/thermal responses far exceed (up to 10 ksi) any stress caused by traffic. They indicate that the boundary conditions act more like a moment-resisting connection with longitudinal restraints, rather than the roller connection assumed for the integral abutment design. These stresses are not explicitly considered in the bridge design.

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The unusual span ratio (0.45) has negatively impacted the bridge's flexibility resulting in early loss of unintended composite action in end-spans. The bridge response to traffic exhibits significant vibrations during and after vehicle crossing as compared to similar bridges. It is believed that these vibrations are caused by excitation of the unusually low natural frequency for the structure (4.6 Hz).

The project findings are important because they are based on actual field measurements. In certain cases they corroborate theory, in other cases there is much less agreement. This points to the fact that the as-built structure may perform differently than calculation and structural analysis would have predicted. Moreover, they pinpoint critical regions within the structure and provide a roadmap as to where to look for early effects of deterioration. Finally, given the conservative assumptions made during design, the observed stress levels and distributions are not expected to affect the safety of the structure. However, they could affect long-term health and performance and adversely impact total life cycle cost. As such, they may have an impact on, or implications for ODOT's design, construction, and/or maintenance practices for this class of bridges.

Second, the field testing and instrumented monitoring techniques, developed as a by-product of the HAM-126-0881 research, have provided researchers and state engineers practical, scientific tools for examining other issues such as capacity rating, rehabilitation, new construction materials, and health assessment of other structures. The research has validated the use of field instrumentation for both short and long term use. Particular field-rugged sensor types and installation methods have been identified along with novel signal conditioning and data acquisition techniques. All of these developments have been integrated in order to provide practical, reliable data collection and estimation of structural parameters such as level of composite action, flexibility, distribution factors, unit influence lines, LFD and WS ratings, etc.

Practical test regimens and field experiments, including truckload tests, modal tests, and calibrated FE models, have been developed and refined to the point where they can be applied with minimum impact on the traveling public.

These methods were successfully translated to Districts 2 (1996) and 10 (2001) to test and field load rate four bridges (LUC-02-0463, LUC-02-1026, LUC-02-1658, WAS-339-2013) in order to corroborate BARS results and support the issuance of superload permits. Temporary monitors were also set in order to capture any damage caused during actual superload transits. The WAS-339-2013 loads (almost 1,000 kips) constituted the largest load to move through the state of Ohio. Similarly, instrumented monitoring methods applied to the Ironton-Russell bridge (LAW-93-0000) in 1999-2000 allowed for both the determination of AASHTO capacity ratings and fatigue life based on field data.

This project continues to push the envelope even today. The facilities at the site have recently been configured into a sort of "intelligent" health monitor. The data acquisition system runs full-time, monitoring bridge traffic responses while at the same time, the on-site PCs continually review WIM data. When a truck is detected, the system activates the camera to take a picture, records the WIM parameters and the bridge's live load response. All of this information is automatically fed into custom software to calculate AASHTO capacity ratings in real-time, and post them to the web at http://www.uc.edu/ucii//.

The same technologies discussed above are being modified for application to the first two cable stayed bridges in Ohio (US Grant and Maumee River Crossing). Results obtained from these monitors and field test methods will shed light on cable stay bridge behavior and assist ODOT in maintenance and inspection activities for the future.

DID YOU INCLUDE YOUR LITERATURE SEARCH?

BY: JANET BIX
ODOT LIBRARIAN

In order to avoid duplicating the efforts of any other research studies, a literature search is now required prior to beginning a new research project. The literature search should cite any existing research, ongoing or completed, on the topic, and show where reports or findings on the subject may be obtained.

For ODOT Technical Liaisons, this means that a copy of preliminary literature search results from the ODOT library, TRIS, RIP, and/or other sources must be attached to the problem statement when it is submitted to R&D. General comments on the results of the search to support the need for this research should also be included.

For researchers submitting a proposal to R&D, this means that any existing research on the topic should be discussed in the "Background and Significance of Work" section of the proposal. A brief summary of literature findings should be presented, and any additional information that demonstrates the project is not a duplication of other ongoing or completed work should also be included.

To assist you with this task, the ODOT library has prepared some guidelines. A good place to start your literature search is:

State Library/ODOT Combined Catalog
For ODOT personnel:
http://intranet.dot.state.oh.us/library/ Click on "ODOT Library/State Library Catalog."
Outside ODOT:
http://slonet.state.oh.us
Here you'll find the entire collection of ODOT research reports, FHWA and DOT reports, archival & current specifications, other state reports, commercially published documents, proceedings, etc. The format will be in paper, video, microfiche, or cd-rom. Some of the records have been linked to full-text documents via the Internet. Items in this catalog can be checked out immediately by any Ohio resident who is registered as a State Library of Ohio patron. This site also posts a link to OhioLINK (Ohio Library and Information Network), a consortium of over 84 institutions, including Ohio college and university libraries and the State of Ohio Library.

ODOT staff have access to most OhioLINK services, including several commercial databases that can provide valuable research information. Click on "Listed by Name" to access an alphabetical list of the following recommended databases:
Applied Science and Technology Abstracts
indexes abstracts and articles in core scientific and technical journals.
Compendex
provides an index and abstracts to engineering literature from international journals, conferences, and reports.
Dissertation Abstracts
contains an index of doctoral dissertations and master's theses from North America and Europe.
Electronic Theses and Dissertations Center
provides online theses and dissertations from Ohio graduate students.
WorldCat
provides a catalog of books and other materials held by libraries worldwide, and includes the resources of the Institute of Transportation Studies Library, University of California at Berkeley; Northwestern University's Transportation Library; and some state DOT libraries.

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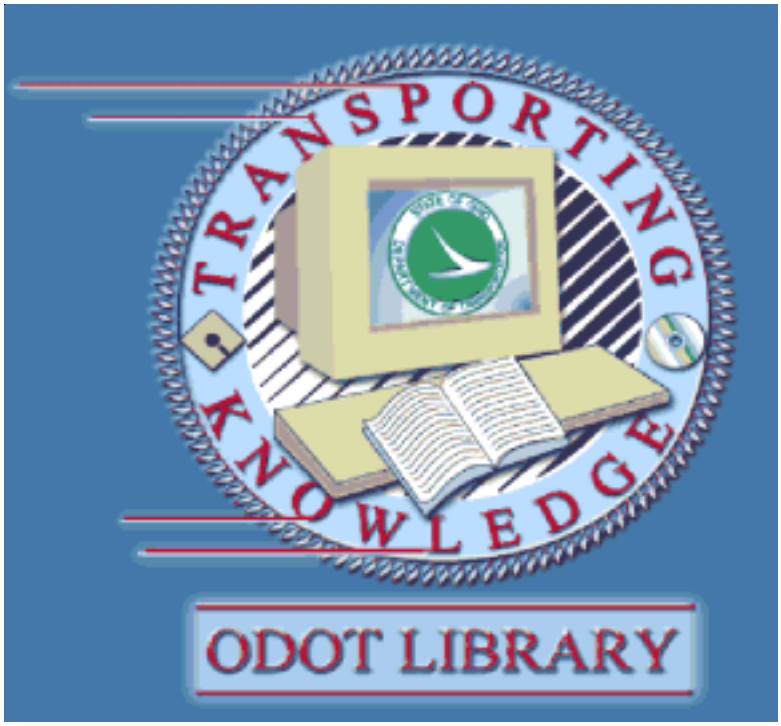
A good database for articles, proceedings. and papers is:
TRIS (Transportation Research Information Service)
http://www.ntl.bts.gov/
This is the National Transportation Library website, the Transportation Research Board's (TRB) database. Click on "TRIS Online". This web version can be searched by author, title, and keyword, but descriptor searching is not available. For ODOT staff, the ODOT Library can perform the search. For others, public libraries often provide this type of search service for a fee. If you need only TRB papers, then the following database is a good place to search:
http://www.nationalacademies.org/. Click on "Transportation" under the subject index, then "Transportation Research Board."

Another useful website:
American Society of Civil Engineers (ASCE) Publications
http://www.pubs.asce.org/cedbsrch.html
ASCE maintains a searchable electronic information retrieval service for all its publications published since 1972. Click on "CE Database" to begin your search.

To avoid duplication of more current research, researchers should also search:
TRB's Research in Progress
http://rip.trb.org
This site contains active research projects of state DOTs, referencing active research projects that will not yet have final publications available.

As a general note, academic and commercial databases operate on boolean logic, meaning you use *and*, *or*, or *andnot* between words or phrases. Make sure you understand the structure and intent of the database you are searching. Many databases use keywords, but some can be searched using descriptors (controlled vocabulary indexers apply). Be sure to look at any tutorials provided and read the help screens for each database you search. Each is indexed a little differently, so the defaults will change from database to database.



2004 OPREP Study

The ODOT Partnered Research Exploration Program (OPREP) has selected its first study. This year's study, titled "Airborne LIDAR: A New Source of Traffic Flow Data", is timely in that it leverages several ongoing efforts – ODOT Aerial Engineering needs, ODOT ITS and Technical Services needs, and National Consortium for Remote Sensing in Transportation programs.

LIDAR (Light Detection and Ranging) is an airborne laser scanning system that, once installed in an aircraft, can deliver surface data at decimeter-level vertical accuracy. It can be used to measure distance, speed, rotation, and chemical composition or concentration of a remote target. ODOT has been investigating the use of LIDAR to look at pavement surface data, but in that case, vehicles on the road represent obstructions to the LIDAR pulses sent to reflect off the pavement, and the data must be processed to remove the vehicle signals. The selected OPREP study will use the LIDAR data as is, including the vehicle signals, to investigate the feasibility of extracting traffic flow information from data collected over transportation corridors. Parameters to be investigated include vehicle identification, classification, and velocity estimation. In addition, the feasibility of real-time data extraction for real-time traffic management will be addressed.

The OPREP program is funded by money set aside specifically to address relevant, innovative research needs that may not have been previously identified by ODOT. The program encourages partnerships among agencies while leveraging both funds and resources. For more information on OPREP, please visit http://www.dot.state.oh.us/divplan/research/newsletter/jan2003.pdf. The study is being performed by Dr. Dorota Grejner-Brzezinska, Dr. Charles Toth, and Dr. Mark McCord of the Ohio State University.

OTEC 2003: Keeping Transportation Safe, Secure & Reliable in the New Ecomony

The 57th annual Ohio Transportation Engineering Conference (OTEC) will be held November 5-6, 2003. The theme of the conference aims to ensure that Ohio has a modern system of roads, capable of moving people and goods safely and efficiently, aiding economic rebound and growth. The latest policy and technical information, as well as new ideas from throughout the transportation industry, will be addressed. Over 140 presenters are scheduled to speak at 54 breakout sessions in the areas of Structures, Pavements & Materials, Traffic, Administration & Management, Safety, Multi-Modal Planning & Environmental Issues, Construction, and Infrastructure Assurance.

This year will be the first time OTEC hosts a Job Fair. Students and industry representatives will be able to schedule interview times during the conference. Detailed information on this opportunity will be included with registration information sent to universities and exhibitors.

For more information on OTEC, please see www.otecohio.org.

Calendar of Events

September - 2003

September 7-10 - International Conference on Highway Pavement Performance, Data Analysis, and Design Applications - For more information go to http://webce.ent.ohiou.edu/ICHP.html

October - 2003

Quarterly progress reports due on all active research projects

November - 2003

November 5-6 - OTEC 2003 - For additional information contact Terri Barnhart via email at terri.barnhart@dot.state.oh.us

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MOVING FORWARD

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